PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.:	10/663,310
Filing Date:	September 16, 2003
Applicant:	Mau-Song Chou et al.
Group Art Unit:	2884
Examiner:	Otilia Gabor
Title:	DETECTION AND ANALYSIS OF CHEMICAL AND BIOLOGICAL MATERALS BY PASSIVE EMISSION OF TERAHERTZ WAVE AGAINST A COLD BACKGROUND TARGET
Attorney Docket:	NGC-00088 (000339-804)

SUBSTITUTE APPEAL BRIEF

This is Appellant's Substitute Brief filed in response to the Notification of Non-Complaint Appeal Brief that was mailed in response to Appellant's Brief filed January 23, 2006 appealing the Examiner's Final Rejection mailed November 4, 2005. This Brief is being submitted in triplicate. Appellant believes that no fees are due.

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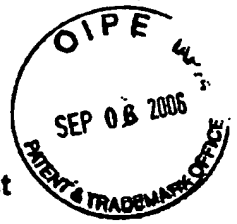

I. Real Party in Interest

The real party in interest for this appeal is Northrop Grumman Corporation of Los Angeles, California, the Assignee of the application.

II. Related Appeals and Interferences

There are no related appeals or interferences.

III. Status of the Claims

Claims 1-65 are pending in this application. Claims 1-3, 5, 12-25, 45-51 and 58-65 stand rejected under 35 USC §103(a) as being unpatentable over U.S. Patent No. 6,242,740 issued to Luukanen et al. (hereinafter Luukanen) in view of U.S. Patent No. 6,853,452 issued to Laufer (hereinafter Laufer) or U.S. Patent No. 6,531,701 issued to Chou et al. (hereinafter Chou) or U.S. Patent No. 6,885,965 issued to Butler et al. (hereinafter Butler). Claims 4, 6-11, 26-44 and 52-57 stand rejected under 35 USC 103(a) as being unpatentable over Luukanen in view of Laufer or Chou and further in view of U.S. Patent Publication No. 2004/0155665 to Amone et al. (hereinafter Amone).

IV. Status of Amendments

All amendments have been entered.

V. Summary of the Claimed Subject Matter

Appellant's claimed invention is a system and method for detecting and analyzing the molecular constituents of chemical and biological materials in a sample. The system

employs a spectrometer for analyzing the molecular constituents in the sample based on molecular spectroscopic properties, i.e., the vibrational and rotational bands of the chemical make-up in the sample.

Independent claims 1 and 58 can be mapped to the embodiments shown in figures 2, 3, 4, 5 and 7. Figure 2 shows a system 38 for detecting and analyzing chemical and biological materials in a sample cloud 12 (paragraphs 26 and 27). A spectrometer device 42 receives passive emissions from the sample cloud 12, and a cold surface 16 is positioned in the field-of-view of the spectrometer device 42. Figure 3 shows a system 50 for detecting and analyzing the chemical and biological materials in a sample 52 (paragraphs 28-30). A spectrometer device 42 receives passive emissions from the sample 52, and a cold surface 16 is positioned in the field-of-view of the spectrometer device 42. Figure 4 shows a system 62 for detecting and analyzing chemical and biological materials in a sample 66 (paragraph 31). A spectrometer device 42 receives passive emissions from a sample 66, and a cold surface 16 is positioned in the field-of-view of the spectrometer device 42. Figure 5 shows a system 70 for detecting and analyzing chemical and biological materials in a sample 72 (paragraphs 32-34). A spectrometer device 80 receives passive emissions 82 from the sample 72, and a cold surface 88 is positioned in the field-of-view of the spectrometer device 80. Figure 7 shows a system 130 for detecting and analyzing chemical and biological materials in air flowing through a vent 132 where the samples are collected by a filter 134 (paragraph 37). Passive emissions 140 from the filter 134 are detected by a spectrometer device 144, and a cryo-cooler 138 is positioned in the field-of-view of the spectrometer device 144.

Independent claim 20 can be mapped to the system 38 shown in figure 2 including the sample cloud 12, the spectrometer device 42 and the cold surface 16 (paragraphs 26 and 27).

Independent claim 26 can be mapped to the system 70 shown in figure 5 including the sample 72, a compartment 74 for holding the sample 72, a transmission window 84 in the compartment 74, a spectrometer device 80 for receiving passive emissions 82 transmitted through the window 84, and a cold surface 88 positioned within the compartment 74 in the field-of-view of the spectrometer device 80 (paragraphs 32-34).

Independent claim 32 can be mapped to the system 50 shown in figure 3 including the sample 52, a transmission window 54 on which the sample 52 is deposited, the spectrometer device 42 and the cold surface 16 positioned in the field of view of the spectrometer device 42 (paragraphs 28-30).

Independent claim 38 can be mapped to the system 62 shown in figure 4 where the sample 66 is contained in a container 64, and where the spectrometer device 42 receives passive emissions from the sample 66 and the cold surface 16 is positioned in the field-of-view of the spectrometer device 42 (paragraph 31).

Independent claim 45 can be mapped to the system 100 shown in figure 6 and the system 38 shown in figure 2. Passive emissions 108 from, for example, the sample cloud 12 are received by a receiver 114 and split by a power splitter 116. The signals are then processed by a spectrometer device including a receiver 102 in two separate channels 104 and 106. Diode detectors 126 provide voltage signals indicative of the received emissions, which are analyzed by an analyzing device that isn't shown. The cold surface can be the cold surface 16 (paragraphs 35 and 36).

Independent claims 52 can be mapped to the system 130 shown in figure 7 where the intake vent 132 collects an air flow through a building, a filter 134 collects particles in the air flow 134, a spectrometer device 144 receives passive emissions from the filter, and a cold surface 138 is positioned in the field-of-view of the spectrometer device 144 (paragraph 37).

Known systems for detecting and analyzing the molecular constituents of chemical and biological materials in a sample in the terahertz frequency band are usually based on absorption spectroscopy. Particularly, a light source is placed behind the sample and a spectrometer measures the absorption spectrum of the sample as the light passes through the sample. Contrary, Appellant's invention employs "emission" spectroscopy. It is typically not possible to measure an emissions spectrum of a sample at the molecular level unless the sample is heated to an elevated temperature relative to the background, such as by using a flame or a high temperature pyrolosis process.

In Appellant's invention, a cold surface is positioned behind the sample opposite and in the field-of-view of the spectrometer so that the emissions spectrum of the sample can be separated from the emissions spectrum of the cold background so that the sample does not need to be heated. In other words, the emissions spectrum of the cold background is much less than the emissions spectrum of the sample because of the temperature difference, thus allowing the emissions spectrum of the sample to be separated from the emissions spectrum of the background and to be detected.

The cold surface can be provided by any suitable cold device that provides a temperature significantly below the temperature of the sample. Suitable examples include liquid-helium dewars and cryogenic coolers. In the embodiments shown in figures 2, 3 and

4, the cold surface is provided by cold surface 16, in the embodiment of figure 5, the cold surface is provided by cold surface 88, and in the embodiment of figure 7, the cold surface is provided by a cryo-cooler 138.

VI. Grounds of Rejection to be Reviewed on Appeal

Whether claims 1-3, 5, 12-25, 45-51 and 58-65 should be rejected under 35 USC §103(a) as being unpatentable over Luukanen in view of Laufer or Chou or Butler, and whether claims 4, 6-11, 26-44 and 52-57 should be rejected under 35 USC §103(a) as being unpatentable over Luukanen in view of Laufer or Chou and in view of Arnone.

VII. Argument

A. Independent claims 1, 20, 26, 32, 38, 45, 52 and 58 are not obvious in view of Luukanen and/or Laufer and/or Chou and/or Butler and/or Arnone.

1. *Prima facie* obviousness

MPEP 2143 states that in order to establish a *prima facie* case of obviousness, three criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references must teach or suggest all of the claim limitations. Appellant submits that the Examiner has not established a *prima facie* case of obviousness because there is no suggestion or motivation in the references to combine the reference teachings, and the references do not teach or suggest all of the claim limitations as will be discussed below.

2. Independent claims 1, 20, 26, 32, 38, 45, 52 and 58

Independent claims 1, 20, 26, 32, 38, 45, 52 and 58 are recreated below.

1. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a spectrometer device responsive to passive emissions from the sample, said emissions being in the terahertz frequency band, said spectrometer device having a field-of-view and generating an emission spectrum of molecular constituents in the sample; and

a cold surface positioned in the field-of-view of the spectrometer device, said cold surface providing a cold background relative to the temperature of the sample.

20. A system for stand-off detecting and analyzing materials in a sample cloud in the air, said system comprising:

a spectrometer device responsive to passive emissions from the sample cloud, said emissions being in the terahertz frequency band, said spectrometer device having a field-of-view and generating an emission spectrum of molecular constituents in the sample cloud; and

a cold surface positioned in the field-of-view of the spectrometer device, said cold surface providing a cold background relative to the temperature of the sample cloud.

26. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a compartment for holding the sample, said compartment including a transmission window;

a spectrometer device responsive to passive emissions from the sample transmitted through the transmission window, said emissions being in the terahertz frequency band, said spectrometer device generating an emission spectrum of molecular constituents in the sample; and

a cold surface positioned in the compartment at an opposite side from the spectrometer device, said cold surface providing a cold background relative to the temperature of the sample.

32. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a transmission window, said sample being deposited on a surface of the transmission window;

a spectrometer device responsive to passive emissions from the sample, said emissions being in the terahertz frequency band, said spectrometer device having a field-of-view and generating an emission spectrum of molecular constituents in the sample; and

a cold surface positioned in the field-of-view of the spectrometer device, said cold surface providing a cold background relative to the temperature of the sample.

38. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a container, said sample being contained in the container;

a spectrometer device responsive to passive emissions from the sample, said emissions being in the terahertz frequency band, said spectrometer device having a field-of-view and generating an emission spectrum of molecular constituents in the sample; and

a cold surface positioned in the field-of-view of the spectrometer device, said cold surface providing a cold background relative to the temperature of the sample.

45. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a spectrometer device responsive to passive emissions from the sample, said emissions being in the terahertz frequency band, said spectrometer device having a field-of-view and generating an emission spectrum of molecular constituents in the sample, said spectrometer device including a power splitter and a plurality of detection channels, said power splitter receiving the emissions and directing the emissions into the plurality of channels so that multiple frequency bands can be simultaneously detected; and

a cold surface positioned in the field-of-view of the spectrometer device, said cold surface providing a cold background relative to the temperature of the sample.

52. A system for detecting and analyzing chemical and biological materials in air flowing through an air intake vent of a building, said system comprising:

a filter positioned in the air intake vent where the air flows through the filter so that particles in the air are captured by the filter;

a spectrometer device positioned at one side of the filter and being responsive to passive emissions from the filter, said spectrometer device generating an emission spectrum of molecular constituents in the filter; and

a cold surface positioned at an opposite side of the filter from the spectrometer device, said cold surface providing a cold background relative to the temperature of the filter.

58. A method for detecting and analyzing chemical and/or biological materials in a sample, said method comprising:

receiving emissions from the sample in a field-of-view of a spectrometer, said emissions being in the terahertz frequency band;

generating an emission spectrum of molecular constituents in the sample in the field-of-view of the spectrometer; and

cooling the background of the sample in the field-of-view of the spectrometer relative to the temperature of the sample.

3. Discussion of Luukanen

Luukanen teaches an imaging system that images an object 114 using a detector matrix 108, such as a bolometer. The Luukanen imaging system measures the object 114 to identify its physical properties, such as its size, shape, surface reflectivity, etc. (column 1, lines 18-30). In one embodiment, the contrast between the object 114 being imaged and the environment can be improved by allowing the object to reflect the radiation of a cold body 111 (column 4, lines 32–36). Alternately, the contrast between the object 114 and the

environment can be improved by lighting the object using a radiation source 112. The radiation emitted, reflected or scattered from the object 114 is collected by a parabolic mirror 110 that focuses the radiation on the detector matrix 108. Thus, it is clear that the Luukanen imaging system does not look at the molecular constituents of the object 114, but only uses the radiation to generate a physical image of the object 114.

The Luukanen imaging system has particular application for searching for hidden weapons and other smuggled articles carried on individuals (column 1, lines 18-20 and column 6, line 47). The Luukanen imaging system does not detect the emissions spectrum of the object 114 being imaged to determine its molecular constituents. The Luukanen detector matrix 108 is not a spectrometer that detects and analyzes the emissions from molecules in a sample, but is a bolometer that images the object being detected. A detailed discussion of the detector matrix 108 can be found in column 4, line 48 – column 5, line 26 of Luukanen. Because the Luukanen imaging system can only detect or measure a physical object of relatively large size, it cannot detect vapor, fine powder, fine liquid droplets and aerosols because of the lack of sufficient reflectivity. Therefore, the Luukanen imaging system cannot determine the chemical nature or chemical composition of the object being imaged. On the other hand, Appellant's system can detect vapor, fine powders, fine liquid droplets and aerosols, and their chemical composition using emissions spectrum analysis.

The cold body 111 in the Luukanen imaging system is used for enhancing the contrast between the object being imaged and its background. This contrast provides better physical resolution for the object being imaged and is not for reducing the emissions spectrum of the background. A discussion of using the cold body 111 to provide this

contrast can be found at column 6, line 44 – column 7, line 8 of Luukanen. In that discussion, Luukanen describes how the cold body 111 provides a detectable temperature difference by varying the ambient temperature to provide the contrast to the object 114. Luukanen does not discuss that the cold body 111 is positioned in the field-of-view of the detector matrix 108, and it is not shown in the field-of-view of the matrix 108 in figure 2. Contrary, the cold body 111 is positioned relative to the object 114 to provide a temperature difference therebetween because the object 114 reflects the radiation of the cold body 111.

In Appellant's claimed invention, the cold surface is used to allow measurements of the emissions spectrum from the sample by suppressing background emissions so that the sample does not need to be heated. This allows sensing and spectroscopic analysis of the molecular constituents of chemical and biological materials. Therefore, Appellant respectfully submits that Luukanen does not teach using a cold background surface in emissions spectrum analysis.

The Examiner states on page 3 of the Final Office Action that the Luukanen system "can be used in a variety of applications including sub-millimeter range spectroscopy, but he fails to specifically disclose that an emissions spectrum is generated from the sample from which the chemical and biological material is present in a sample are detected. However, since spectroscopy inherently means generation of spectrum radiation from the sample, and since the Luukanen system works in the passive mode, it would have been obvious that by stating that sub-millimeter spectroscopy applications are possible to mean passive emissions spectral generation as disclosed by Laufer."

Appellant respectfully submits that the Examiner has improperly characterized the teaching of Luukanen because Luukanen only teaches imaging an object, and does not

teach or suggest analyzing the spectral content of emissions from the sample. In other words, the Luukanen system looks at the object as a whole, and does not look at radiation passively emitted from the object. Luukanen states at column 12, lines 43-48 that the Luukanen imaging system can be used for sub-millimeter range spectroscopy for the detection of metals, measurement of thicknesses and moisture content of dielectric materials, topological surveys, temperature analysis of an object, etc. Luukanen goes on to say that the system can also be used for the image heads for missiles self-guided to a target. However, Appellant submits that all of these applications are imaging applications where an object is looked at in its entirety, and not an emissions spectrum from the object.

4. Discussion of Laufer

Laufer discloses a sensor for detecting the absorption or emissions spectrum of target chemical species. The Laufer sensor has particular application for the UV through IR regions of the spectrum and not the terahertz frequency band (column 11, lines 19 – 23). Column 11, lines 29-33 of Laufer states "that emission spectra are obtained when the target species is warmer than its surroundings, e.g., when detecting a cloud of chemical pollutants by a far infrared detector facing the sky." Figure 2 shows that a target cloud emits a light beam 22, where the cloud has been heated by the sun. In order to separate the absorption or emissions spectrum of the target chemical species, the Laufer sensor employs a sample filter assembly 10, 44 and a reference filter assembly 14, 46 that receive the emissions from the sample. The filtered signals from the filter assemblies are detected by detectors 26, 60 and 28, 60, respectively. The sample and reference signals are then compared to eliminate or reduce common noise components, variations in source power

and absorption by interfering species (column 12, lines 40-45). In order to detect the absorption or emissions spectrum of a chemical species, the target species must be warmer than the surrounding background by using the sun or some other artificial light source (column 11, lines 24 – 36).

As discussed above, Appellant's claimed system provides the contrast of the sample emissions spectrum relative to the background by providing a cold surface behind the sample being detected and in the field-of-view of the spectrometer. Laufer does not use a cold surface for this purpose, but requires that the sample be warmer than its background, and then uses a reference filter to reduce noise. Further, Laufer discloses detector assemblies for detecting the light radiation, and not a spectrometer for separating the molecular constituents of the radiation to determine the molecular constituents of the sample.

Because Laufer does not teach or suggest using a cold surface for detecting and analyzing the emissions spectrum to detect molecular constituents of the sample, Appellant respectfully submits that Laufer cannot provide the teaching missing from Luukanen to make Appellant's claimed invention obvious. Particularly, Luukanen only teaches using a cold background as a contrast for imaging an object and Laufer only teaches heating a sample relative to the background to provide emissions spectrum contrast. Therefore, Appellant respectfully submits that Luukanen and Laufer cannot be combined to teach or suggest the combination of using a cold background for detecting and analyzing the emissions spectrum to identify a molecular constituents in a sample.

5. Discussion of Chou

Chou discloses a system for the remote detection and analysis of chemical agents in the air. Chou uses a spectrometer to analyze the emissions spectrum of a sample, such as a cloud 28. However, Chou uses a radiation source 12 to generate a radiation beam 22 to heat the cloud to increase its emission spectrum relative to the cooler background (column 3, lines 40-47). Chou does not teach or suggest using a cold surface in the background of the sample being detected and the field-of-view of the spectrometer to analyze the emissions spectrum from the sample as in Appellant's claimed invention. Therefore, Appellant respectfully submits that Chou also fails to provide the teaching necessary to make Appellant's independent claims obvious.

6. Discussion of Butler

Butler discloses a system for detecting constituents in a gaseous plume 103 using an infrared spectrometer 101, where a background 105 relative to the plume 103 is significantly warmer (column 1, line 49). The system uses an infrared spectrometer (column 5, line 32) to analyze an adsorption spectrum from the sample (column 6, line 5). The analysis technique disclosed by Butler compares a sample spectrum to a known temperature spectrum in order to determine a sample background spectrum (column 6, lines 6-15). The Examiner does not appear to discuss the relevance of Butler to the claimed invention in the Final Office Action. Appellant submits that Butler does not teach or suggest using a cold surface in the background of a sample being analyzed by molecular spectroscopy. Therefore, Appellant submits that Butler also fails to provide the teaching necessary to make Appellant's claimed invention obvious.

7. Discussion of Arnone

Arnone discloses a Terahertz generator 1 that radiates a sample 3, and a detector 5 that detects the amplitude and phase of the radiation emitted from the sample 3. It is believed that the Examiner is relying on Arnone to teach analyzing a sample that is contained in a sample container or filter. As with Luukanen above, the Arnone system is an imaging system for imaging an object (paragraph 2). The detector 5 is not a spectrometer for analyzing an emissions spectrum, but detects the amplitude and phase of the radiation emitted from the sample 3 (paragraph 102). Arnone fails to teach or suggest a spectrometer for analyzing the molecular constituents of a sample in the terahertz frequency range, where a cold surface is positioned behind the sample to increase the emissions spectrum of the sample.

Independent claim 52 includes a filter positioned at the air intake vent of a building that collects particles in the air, a spectrometer that receives passive emissions from the filter and generates an emissions spectrum of the constituents in the emissions, and a cold surface positioned at an opposite side of the filter of the spectrometer. Appellant can find no teaching or suggestion in Arnone of a system for detecting and analyzing chemical and biological materials by emissions spectroscopy that includes a filter for collecting the particles in an air flow. The Examiner discusses Arnone on page 5, section 5 of the Final Office Action, but does not specifically state in Arnone where this teaching can be found. Appellant submits that Arnone fails to provide the teaching necessary to make Appellant's claimed invention obvious.

8. Discussion of the Art

The prior art of record that discusses emissions spectroscopy either heat the sample or heat the background to separate the emissions of the sample from the background emissions. Luukanen uses a cold surface in the background of an imaging system, and not an emissions spectroscopy system. Appellant respectfully submits that the Examiner has not established a *prima facie* case of obviousness because the references do not teach or suggest providing a cold surface in the background of a sample and in the field-of-view of a spectrometer to reduce the emissions spectrum of the background to better receive the emissions spectrum from the sample. The Luukanen cold surface is not used to reduce the background emissions to separate the sample emissions, as in Appellant's claimed invention. Therefore, Appellant submits that using a cold surface in emissions spectroscopy is not fairly taught or suggested by the prior art of record.

B. Dependent claims 2–19, 21–25, 27–31, 33–37, 39–44, 46–51, 53–57 and 59–65 are not obvious in view of the combination of Luukanen and/or Laufer and/or Chou and/or Butler and/or Arnone

Appellant's dependent claims include various types of samples and sample containers, such as sample compartments, airborne clouds, transmissive substrates, filters, envelopes, cardboard enclosures, plastic containers, glass containers, etc. Appellant submits that the prior art of record does not teach the combination of these types of samples in sample containers in combination with a cold background. Therefore, Appellant respectfully submits that the dependent claims are not made obvious in view of the teachings of Luukanen, Laufer, Chou, Butler and/or Arnone.

VIII. Conclusion

Appellant respectfully submits that claims 1-3, 5, 12-25, 45-51 and 58-65 are not obvious in view of the combination of Luukanen and Laufer or Chou or Butler, and claims 4, 6-11, 26-44 and 52-57 are not obvious in view of Luukanen and Laufer or Chou, and Arnone. It is therefore respectfully requested that the Examiner's Final Rejection under 35 USC §103(a) be reversed, and that Appellant's claims be allowed.

Respectfully submitted,

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CLAIMS APPENDIX

COPY OF CLAIMS INVOLVED IN THE APPEAL

1. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a spectrometer device responsive to passive emissions from the sample, said emissions being in the terahertz frequency band, said spectrometer device having a field-of-view and generating an emission spectrum of molecular constituents in the sample; and

a cold surface positioned in the field-of-view of the spectrometer device, said cold surface providing a cold background relative to the temperature of the sample.

2. The system according to claim 1 wherein the cold surface includes a terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

3. The system according to claim 1 wherein the spectrometer device is a Fourier transform spectrometer providing a spectrum analysis of the emissions.

4. The system according to claim 1 further comprising a sample compartment, said sample being confined within the compartment.

5. The system according to claim 1 wherein the sample is within an airborne cloud.

6. The system according to claim 1 further comprising a transmissive substrate, said sample being placed on the transmissive substrate.

7. The system according to claim 6 wherein the transmissive substrate is a plastic window or an anti-reflective coated silicon window.

8. The system according to claim 1 further comprising a filter, said sample being in the filter.

9. The system according to claim 8 wherein the filter is positioned within an air intake vent of a facility.

10. The system according to claim 1 further comprising a container, said sample being contained in the container.

11. The system according to claim 10 wherein the container is selected from the group consisting of an envelope, a cardboard enclosure, a plastic container and a glass container.

12. The system according to claim 1 further comprising an antenna, said antenna collecting the emissions and directing the emissions to the spectrometer device.

13. The system according to claim 12 wherein the antenna is selected from the group consisting of a feed horn and a Cassegrain-type telescope.

14. The system according to claim 1 further comprising a collimator, said collimator focusing the field-of-view of the spectrometer device onto the cold surface.

15. The system according to claim 14 wherein the collimator is a Cassegrain-type telescope.

16. The system according to claim 1 wherein the spectrometer device includes a power splitter and a plurality of detection channels, said power splitter receiving the emissions and directing the emissions into the plurality of channels so that multiple frequency bands can be simultaneously detected.

17. The system according to claim 1 wherein the spectrometer device includes a terahertz receiver for receiving and amplifying signals in the terahertz frequency band.

18. The system according to claim 1 wherein the terahertz frequency band includes microwave, millimeter wave and sub-millimeter wave frequency bands.

19. The system according to claim 1 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, a liquid aerosol sample, a particulate aerosol sample, a bio-aerosol sample, a vapor sample, a gas sample, chemical agents,

biological agents, industrial chemicals, toxins, drugs, fungi, pollens, and explosives in the form of vapor, powder, liquid or aerosol.

20. A system for stand-off detecting and analyzing materials in a sample cloud in the air, said system comprising:

a spectrometer device responsive to passive emissions from the sample cloud, said emissions being in the terahertz frequency band, said spectrometer device having a field-of-view and generating an emission spectrum of molecular constituents in the sample cloud; and

a cold surface positioned in the field-of-view of the spectrometer device, said cold surface providing a cold background relative to the temperature of the sample cloud.

21. The system according to claim 20 wherein the cold surface is made of a terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

22. The system according to claim 20 wherein the spectrometer device is a Fourier transform spectrometer providing a spectrum analysis of the emissions.

23. The system according to claim 20 further comprising a collimator, said collimator focusing the field-of-view of the spectrometer device onto the cold surface.

24. The system according to claim 20 wherein the terahertz frequency band includes microwave, millimeter wave and sub-millimeter wave frequency bands.

25. The system according to claim 20 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, a liquid aerosol sample, a particulate aerosol sample, a bio-aerosol sample, a vapor sample, a gas sample, chemical agents, biological agents, industrial chemicals, toxins, drugs, fungi, pollens, and explosives in the form of vapor, powder, liquid or aerosol.

26. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a compartment for holding the sample, said compartment including a transmission window;

a spectrometer device responsive to passive emissions from the sample transmitted through the transmission window, said emissions being in the terahertz frequency band, said spectrometer device generating an emission spectrum of molecular constituents in the sample; and

a cold surface positioned in the compartment at an opposite side from the spectrometer device, said cold surface providing a cold background relative to the temperature of the sample.

27. The system according to claim 26 wherein the cold surface is made of a terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

28. The system according to claim 26 wherein the spectrometer device is a Fourier transform spectrometer providing a spectrum analysis of the emissions.

29. The system according to claim 26 further comprising a collimator, said collimator focusing a field-of-view of the spectrometer device onto the cold surface.

30. The system according to claim 26 wherein the terahertz frequency band includes microwave, millimeter wave and sub-millimeter wave frequency bands.

31. The system according to claim 26 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, a liquid aerosol sample, a particulate aerosol sample, a bio-aerosol sample, a vapor sample, a gas sample, chemical agents, biological agents, industrial chemicals, toxins, drugs, fungi, pollens, and explosives in the form of vapor, powder, liquid or aerosol.

32. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a transmission window, said sample being deposited on a surface of the transmission window;

a spectrometer device responsive to passive emissions from the sample, said emissions being in the terahertz frequency band, said spectrometer device having a field-of-view and generating an emission spectrum of molecular constituents in the sample; and

a cold surface positioned in the field-of-view of the spectrometer device, said cold surface providing a cold background relative to the temperature of the sample.

33. The system according to claim 32 wherein the cold surface is made of a terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

34. The system according to claim 32 wherein the spectrometer device is a Fourier transform spectrometer providing a spectrum analysis of the emissions.

35. The system according to claim 32 further comprising a collimator, said collimator focusing the field-of-view of the spectrometer device onto the cold surface.

36. The system according to claim 32 wherein the terahertz frequency band includes microwave, millimeter wave and sub-millimeter wave frequency bands.

37. The system according to claim 32 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, a liquid aerosol sample, a particulate aerosol sample, a bio-aerosol sample, a vapor sample, a gas sample, chemical agents,

biological agents, industrial chemicals, toxins, drugs, fungi, pollens, and explosives in the form of vapor, powder, liquid or aerosol.

38. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a container, said sample being contained in the container;

a spectrometer device responsive to passive emissions from the sample, said emissions being in the terahertz frequency band, said spectrometer device having a field-of-view and generating an emission spectrum of molecular constituents in the sample; and

a cold surface positioned in the field-of-view of the spectrometer device, said cold surface providing a cold background relative to the temperature of the sample.

39. The system according to claim 38 wherein the container is selected from the group consisting of an envelope, a cardboard enclosure, a plastic container and a glass container.

40. The system according to claim 38 wherein the cold surface is made of a terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

41. The system according to claim 38 wherein the spectrometer device is a Fourier transform spectrometer providing a spectrum analysis of the emissions.

42. The system according to claim 38 further comprising a collimator, said collimator focusing the field-of-view of the spectrometer device onto the cold surface.

43. The system according to claim 38 wherein the terahertz frequency band includes microwave, millimeter wave and sub-millimeter wave frequency bands.

44. The system according to claim 38 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, a liquid aerosol sample, a particulate aerosol sample, a bio-aerosol sample, a vapor sample, a gas sample, chemical agents, biological agents, industrial chemicals, toxins, drugs, fungi, pollens, and explosives in the form of vapor, powder, liquid or aerosol.

45. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a spectrometer device responsive to passive emissions from the sample, said emissions being in the terahertz frequency band, said spectrometer device having a field-of-view and generating an emission spectrum of molecular constituents in the sample, said spectrometer device including a power splitter and a plurality of detection channels, said power splitter receiving the emissions and directing the emissions into the plurality of channels so that multiple frequency bands can be simultaneously detected; and

a cold surface positioned in the field-of-view of the spectrometer device, said cold surface providing a cold background relative to the temperature of the sample.

46. The system according to claim 45 wherein the cold surface is made of a terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

47. The system according to claim 45 wherein the spectrometer device includes a radiometer in each channel.

48 The system according to claim 47 wherein each radiometer includes a mixer for down-converting the emissions, an intermediate frequency amplifier for amplifying the down-converted emissions and a diode detector for detecting the amplified and down-converted emissions.

49. The system according to claim 45 further comprising a collimator, said collimator focusing the field-of-view of the spectrometer device onto the cold surface.

50. The system according to claim 45 wherein the terahertz frequency band includes microwave, millimeter wave and sub-millimeter wave frequency bands.

51. The system according to claim 45 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, a liquid aerosol sample, a particulate aerosol sample, a bio-aerosol sample, a vapor sample, a gas sample, chemical agents, biological agents, industrial chemicals, toxins, drugs, fungi, pollens, and explosives in the form of vapor, powder, liquid or aerosol.

52. A system for detecting and analyzing chemical and biological materials in air flowing through an air intake vent of a building, said system comprising:

a filter positioned in the air intake vent where the air flows through the filter so that particles in the air are captured by the filter;

a spectrometer device positioned at one side of the filter and being responsive to passive emissions from the filter, said spectrometer device generating an emission spectrum of molecular constituents in the filter; and

a cold surface positioned at an opposite side of the filter from the spectrometer device, said cold surface providing a cold background relative to the temperature of the filter.

53. The system according to claim 52 wherein the cold surface is made of a terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

54. The system according to claim 52 wherein the spectrometer device is a Fourier transform spectrometer providing a spectrum analysis of the emissions.

55. The system according to claim 52 further comprising a collimator, said collimator focusing the field-of-view of the spectrometer device onto the cold surface.

56. The system according to claim 52 wherein the emissions are in the terahertz frequency band.

57. The system according to claim 52 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, a liquid aerosol sample, a particulate aerosol sample, a bio-aerosol sample, a vapor sample, a gas sample, chemical agents, biological agents, industrial chemicals, toxins, drugs, fungi, pollens, and explosives in the form of vapor, powder, liquid or aerosol.

58. A method for detecting and analyzing chemical and/or biological materials in a sample, said method comprising:

receiving emissions from the sample in a field-of-view of a spectrometer, said emissions being in the terahertz frequency band;

generating an emission spectrum of molecular constituents in the sample in the field-of-view of the spectrometer; and

cooling the background of the sample in the field-of-view of the spectrometer relative to the temperature of the sample.

59. The method according to claim 58 wherein the sample is confined in a sample compartment, concealed in a container, airborne, captured in a filter or placed on a transmissive substrate.

60. The method according to claim 58 wherein the spectrometer is selected from the group consisting of a Fourier transform spectrometer or a radiometer.

61. The method according to claim 58 wherein the cold surface is made of terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

62. The method according to claim 58 further comprising focusing the field-of-view of the spectrometer onto the cold surface.

63. The method according to claim 58 further comprising splitting the emissions into a plurality of detection channels for detecting a plurality of frequency bands.

64. The method according to claim 58 wherein the terahertz frequency band includes microwave, millimeter wave and sub-millimeter wave frequency bands.

65. The method according to claim 58 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, an aerosol sample, a vapor sample, a gas sample, chemical agents, biological agents, industrial chemicals, toxins, drugs, fungi, pollens and explosives.

EVIDENCE APPENDIX

There is no evidence pursuant to §1.130, §1.131 or §1.132.

RELATED PROCEEDINGS APPENDIX

There are no decisions rendered by a court or the Board in any proceeding identified in Section II of this Appeal Brief.